FACTORS INFLUENCING THE LEARNING PERFORMANCE OF u-LEARNING SYSTEMS

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Abstract: This study examines the factors that are associated with user satisfaction of ubiquitous learning (u-Learning), where in four major factors are identified that influence interaction and learning performance. A survey of 226 u-Learning users was conducted and the data collected was used to test theoretically expected relationships. To verify the research model, the validity through the model's factor and reliability analyses was inspected. The results of the analyses, by LISREL, are as follows. First, the ubiquitous characteristics such as pervasive connectivity and context awareness had significant influence on the effectiveness of the u-Learning systems. Second, the learner's characteristics such as academic motivation and flow played an important role in the effectiveness of u-Learning systems. Third, the learner's interaction factors had an important influence regarding the performance of u-Learning systems.

1 INTRODUCTION

With the revolution in computing and wireless network technology, the advanced knowledge and information in the 21st century have introduced a ubiquitous computing environment. Since the ubiquitous technology was developed in 2003, the development of information and communication in the 21st century has continued to transform the information paradigm line with the computerization that was enabled in the 80's, and the information and knowledge age in the 90's (Ha, et. al, 2002). The major ubiquitous computing technologies include sensing, network, interface, interaction, security-privacy, hardware platform embedded software, and application programs (The Electronic Times, 2005). The services produced by them are u-communication, u-information, u-situation recognition, u-intelligence service, etc. (KERIS, 2006). In the ubiquitous society, the development of ubiquitous computing technology leads to changes in politics, economy, and culture, and enables building up a new social structure (National Information Society Agency, 2005).

In light of this new technology, it is time to consider defining the capabilities that this ubiquitous society requires. Also, it is necessary to know how education must be done accordingly in the forthcoming ubiquitous era and how to set up its vision and practical strategies to accomplish it. The possibility of ubiquitous learning (u-Learning) as a future educational technology increases with educational efforts for detecting social changes caused technological development and for nurturing talented people for the next generation that allows a learner to study freely regardless of time and place as long as he/she is in a ubiquitous learning. This can be achieved through an improved learner-oriented education environment or daily space as well as the traditional schools into a learning place.

Ubiquitous computing technology can be used to minimize this problem. Also, it could maximize the effectiveness of teaching and learning by upgrading information technology-based facilities to support ubiquitous technology.

And by using u-Learning systems, it could encourage the development and use of electronic textbooks. It is impossible for paper-based textbooks, which have usability and economical efficiency, to be substitutes to electronic based textbooks in a short time.

In Korea, there have been diverse studies on the vision and strategies of the future of education today (Koh & Kim, 2005; Kim & Kwon, 2006). The Department of Information Systems, Education and Human Resources in particular has actively studied these issues by applying new methods in public education. One of the most recent efforts was to test a u-Learning education at some of the experimental schools and continue the studies on the teaching-learning strategies (MOE, 2005). Also, an alternative teaching-learning model for u-Learning has been developed (Seo, et al., 2006).

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The purpose of this study is to suggest the major agendas of u-Learning environment in order to nurture capable men equipped with these abilities.

2 THEORETICAL BACKGROUND

2.1 Analyzing the Effectiveness of u-Learning Characteristics

2.1.1 Pervasive Connectivity

Pervasive connectivity is the ability to consume local, broadband access to worldwide information networks, services, and individuals anytime and anywhere they are convenient. Information connectivity is the ability to access and retrieve information from the web. Unlike messaging, this requires a mobile device to maintain a real-time connection to the Internet. At a minimum, wireless browsers should become commonplace before this phase takes off (Kalakota, et al., 2002).

Real time messaging must also be able to cross-connect channels (Kalakota, et al., 2002). And location-based applications capitalize on the mobile network instructor's knowledge of where the educator is at any given time.

2.1.2 Context Awareness

Context is used to automate and facilitate the communication, collaboration, and coordination among people, for example, by forwarding incoming phone calls to a person's current location, by determining the communication media for which a person can be contacted at a given point in time or automatically choosing the most suitable communication media for which a person can be contacted at a given point in time or automatically choosing the most suitable communication channel in a given situation.

A context consists of the set of circumstances and conditions that can be spatial, temporal, situational, personal, social, cultural, ecological, etc. (Gershenson, 2002). Context, also, is a powerful and longstanding concept in learning theory and human-computer interaction. Interaction with computation is by explicit acts, making communication much more efficient. Thus, by carefully embedding computing into the context of our life activities, it can serve us with minimal effort on our part. Communication can not only be effortless, but it can also fit naturally into our ongoing activities. Pushing this further, the activities, and the computation becomes invisible.

2.1.3 Learning Motivation

Motivation by definition is the degree of the choices people make and the degree of effort they will exert (Keller, 1983). Several theories have provided theoretical frameworks for understanding motivation (Pintrich & Schunk, 1996). Among different constructs on motivation, continuing motivation and intrinsic motivation are the most significant for instructional theory and research (Kinzie, 1990). Intrinsic motivation is defined as the motivation to engage in an activity "for its inherent satisfactions rather than for some separable consequence" (Ryan & Deci, 2000). Theories of motivation and empirical evidence have suggested several sources of intrinsic motivation. Some motivational researchers posit that activities providing learners with a sense of control over their academic outcomes may enhance intrinsic motivation (Pintrich & Schunk, 1996). Lepper and Hodell (1989) have identified challenge, curiosity, control, and fantasy as primary characteristics of tasks that promote intrinsic motivation.

Continuing motivation is the type of intrinsic motivation most directly concerned with education and it reflects an individual's willingness to learn (Maeher, 1976). Studies have been done on how to improve learner motivation. Some theorists contend that the primary reward for the learner is the activity itself; thus, continuing motivation is facilitated by an intrinsic interest in the activity (Condry & Chambers, 1978).

It is important to review past studies on motivational issues in computer-assisted instruction and distance education settings, since motivational features that encountered these settings are similar to those in Web-based instruction (Song, 2000). Kinzie (1990) argues that intrinsic and continuing motivation are important components in computer-based instruction.

Learning has been done on motivational influences in online settings. Several research studies suggest that motivation to learn via a particular medium is influenced by the learner's beliefs about his own ability and the difficulty level of the task, rather than by the medium per se (Clark, 1994). In addition, Keller (1999) posits that learner support is important for motivation learners in Web-based instruction.

2.1.4 Flow

The flow theory becomes one of the most important frameworks in the internet research arena. Hoffman

and Novak proposed a hierarchical flow model showing the antecedents and outcomes of flow and the relationship among these variables in the hyper-media computer circumstances (Hoffman, et al., 1996). This model was further tested after their initial research (Novak, et al., 2000).

In their paper, Hoffman and Novak explained that the balance of challenge and skill leads to the flow which means the positive optimal state of mind (Hoffman, et al., 1996). An imbalance between challenge and skill, leads to negative states of mind like anxiety, boredom, apathy (Csikszentmihalyi, et al., 1988). Almost all research on the flow 4-channel model has been focusing on flow, the positive state of mind (Ellis, 1994; Mathwick, et al., 2004). However, it also needs to examine the formation of the negative states of minds and their outcomes.

Flow researchers explain play or playfulness as antecedents or the early state of flow. However, play has been regarded as a distinct concept from flow in the flow literatures (Hoffman, et al., 1996; Novak, Hoffman, et al., 2000). Mathwick and Rigdon discovered the influences of challenge and skill on play; they also observed the influence of play on web-loyalty and brand loyalty (Mathwick, et al., 2004).

This paper attempts to analyze the relationships among the state of mind, the skill of play, the challenge, and interest for learning.

2.2 Moderating factors

2.2.1 Learner's Interactivity

Interactivity is another area of instructional method, and there have been a few studies to make comprehensive instructional models for interactivity in Web or hypertext environments. Choi (1999) investigated the effects of instructional strategies for interactivity in Web-based instruction. Lim (1999) proposed a set of systematic prescriptions for designing interactive Web-based instruction. Kim (1998) explored strategies for interaction in hypertext systems. Besides motivation and interactivity, a few instructional design models have been studied for other instructional methods. For example, a design model for learner control was suggested by Chung (1994).

2.3 Analyze the Performance of u-Learning with Regard to the Learners' Perspective

2.3.1 Self-Directed Learning

The present study investigated learners of self-directed learning courses of answer aforementioned research questions. Here, self-directed learning courses refer to courses delivered via the Web in which learners go through instructional materials delivered via the Web at their own pace without the presence of an instructor. Learners can participate in u-Learning in various contexts, yet the self-directed u-Learning format is the focus of this study because it is a primary instructional format in training settings for learners (Driscoll, 2002; Galvin, 2002).

2.3.2 Problem-Solving

In a knowledge-information based society, problem-solving capabilities are very important in utilizing knowledge and information in problem situations. Many research and studies on the learning effectiveness of problem-solving learning, are, in general, categorized into two parts: One is about cognitive aspects which deal mostly with the issues on improvement of learning acquisition, critical thinking, and problem-solving skills; the other is about affective aspects including learning motivation, and self-confidence as a learner (DeVries et al., 1994).

Recently, one of the main streams of instructional methods has involves problem solving. Problem solving, which is any goal-directed sequence of cognitive operations and mental processes, is the most important cognitive activity within an educational goal setting (Jonassen, 2000; Phye, 2001). Research on the effectiveness of problem solving has been examined, thus most problem solving is conducted and designed to develop competence in solving problems via collaborative efforts.

2.3.3 Satisfaction

An important step that is typically required prior to implementing e-Learning is the selection of a suitable learning management system (Govindasamy, 2002). Like any other information system, the success of learning management stems largely from user satisfaction (Bharati, 2003; DeLone and McLean, 1992; Doll and Torkzadeh, 1992; Seddon, 1997) and other such factors. Stokes (2001) indicated that the issue of learner satisfaction, within the digital environment, is very important.

Thus, satisfaction with u-Learning is most frequently used as one of many indicators of effectiveness in u-Learning. The questionnaire to measure learners' satisfaction with u-Learning was interchangeable with research purpose or the intentions of the research institution.

3 THE METHODOLOGY

This study examined the relationship between the mandatory adoption of ubiquitous information technology and the performance of e-Learning or u-Learning. Fig.1 shows the proposed model and hypotheses.

Recently, interest in the usage of ubiquitous applications in the learning environment has increased. Previous research mainly provided general overviews of technical concepts and issues that were based on evidence, thus less attention was being paid to the empirical validation of the relationship between ubiquitous technology accepting and e-Learning market performance. Several research efforts in the area of e-Learning apply the technology acceptance model (TAM) to the sales force setting on user's Satisfaction, however, these studies focus on volitional technology acceptance, thus in general they fail to consider the unique features of mandatory u-Learning learners.

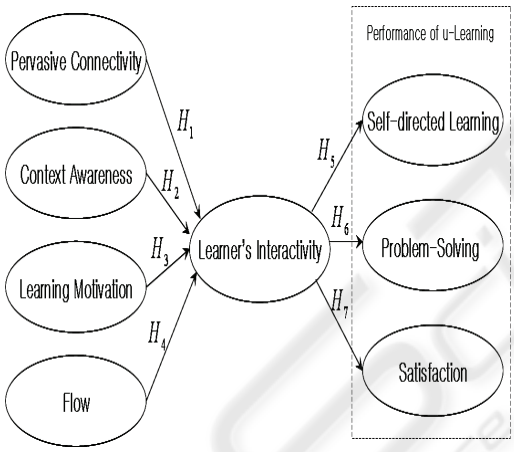

Figure 1: The proposed model and hypotheses.

H_1: Pervasive Connectivity has a positive effect on Learner's Interactivity

H_2: Context Awareness has a positive effect on Learner's Interactivity

H_3: Learning Motivation has a positive effect on Learner's Interactivity

H_4: Flow has a positive effect on Learner's Interactivity

H_5: Learner's Interactivity has a positive effect on Self-directed Learning

H_6: Learner's Interactivity has a positive effect on Problem-Solving

H_7: Learner's Interactivity has a positive effect on Learner's Satisfaction

4 RESEARCH DESIGN

4.1 Sample and Data Collection

In order to derive the preference structure, a survey was carried out. Data was gathered from students experienced u-Learning at a large university in Daegu of South Korea.

The subjects for this study were u-Learning learners who had fully experienced u-Learning interactivity. For this study, a survey (face-to face) was conducted.

Table 1: Demographics profile of the respondents.

Item	Category	Frequency (people)	Percent (%)
Gender	Male	123	54.4
	Female	113	45.6
Age	15-25 years	76	33.6
	26-35 years	94	41.6
	36-45 years	32	14.2
	> 46 years	24	10.6
Occupation	Undergraduate students	156	69.0
	Company employees	45	19.9
	Etc.	21	9.3
Education	High school graduates	23	10.2
	Attending universities	101	44.7
	Bachelors degree	65	29.8
	Advanced degree	37	16.4
Goal for the u-Learning	Learn the foreign language	112	49.6
	Acquiring the degree	25	11.1
	Acquiring the license	72	31.9
	Etc.	17	7.5
Total		226	100

A total of 226 valid samples were returned. Among the 266 respondents, 123 were male (54.4%) and 113 were female (45.6%); 76 were 15-25 years (33.6%), 94 were 26-35 years (41.6%), 32 were 36-45 years (14.2%) and 24 were 46 years and over (10.6%); 156 were student s(69.0%), 45 were workers (19.9%), 21 were Etc. (9.3%); As the degree of scholarship were 23 were high school graduates (10.2%), 101 were attending universities (44.7%), 65 were masters (29.8%), 37 had a master degree or higher (16.4%);

As for the goal of u-Learning 112 were taking it foreign language (49.6%), 25 were trying to academic degree acquire (11.1%), 72 were trying to acquire a licence degree (31.9%), 17 were others. The demographic profile of the respondents is shown in Table 1.

4.1.1 Measures

Table 2: The results of reliability and variance analysis (n=226).

Variables	Cronbach Alpha	No. of Items	Mean	S.D
Pervasive Connectivity	0.880	3	4.084	1.557
Context Awareness	0.876	3	4.220	1.406
Learning Motivation	0.879	3	4.423	1.267
Flow	0.885	3	4.491	1.525
Learner's Interactivity	0.877	4	3.983	1.522
Self-directed Learning	0.876	2	4.559	1.270
Problem Solving	0.876	2	4.508	1.425
Satisfaction	0.877	2	4.457	1.140

The survey instruments were developed based on measures from the literature that were modified via preliminary interviews with selected u-Learning learners. Participants indicated their level of agreement or disagreement using a seven-point Likert scale.

The results of a reliability analysis of the research variables are shown in Table 2. Internal consistency, as measured by Chronbach's alpha for all variables, ranges between 0.876 and 0.885.

5 DATA ANALYSIS AND RESULTS

The empirical analysis was analyzed with significance of p<0.10. SPSS 12.1 and LISREL 8.70 were used for the empirical analysis. The empirical analysis procedure used in the study is shown below (figure 2. and table 3).

The hypothesis was tested by using LISREL 8.70. According to the results from the structural equation model of variance presented in Table 1. and Fig 2.

Partial support is given for Hypotheses H1, H2, H3, H4, H5, H7 in a significant positive association between individual differences and the effectiveness of the u-Learning systems. However Hypotheses H6 was rejected.

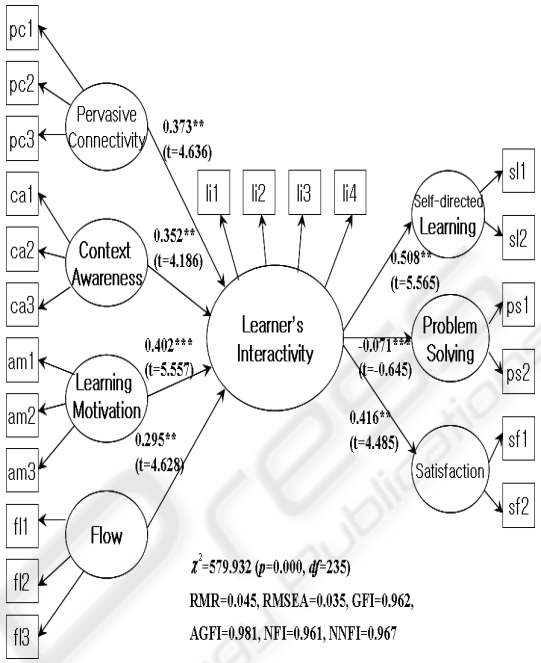

Figure 2: Analysis of the research model results.

Table 3: Results of the Hypotheses Test.

	Hypothesized Path	Standardized Coefficient	t-value	Result
H_1	Pervasive Connectivity → Learner's Interactivity	0.373**	4.636	+
H_2	Context Awareness → Learner's Interactivity	0.352**	4.186	+
H_3	Learning Motivation → Learner's Interactivity	0.402***	5.557	+
H_4	Flow → Learner's Interactivity	0.295**	4.628	+
H_5	Learner's Interactivity → Self-directed Learning	0.508**	5.565	+
H_6	Learner's Interactivity → Problem Solving	-0.071***	-0.645	-
H_7	Learner's Interactivity → Satisfaction	0.416**	4.485	+

*(p; *<0.01, **<0.05, ***<0.001)*

In this study the results show that the learner's interactivity factors had an influence on the performance of the u-Learning system. Data from a survey of 226 u-Learning users were used to test the research model. Also, the validity of the model through factors, and analyze. The results of data analysis by LISREL are as follows. First, ubiquitous characteristics, pervasive connectivity and context awareness had a significant influence on the

effectiveness of u-Learning systems. Second, learner's characteristics, academic motivation and flow played an important role in the effectiveness of u-Learning. Finally, learner's interactivity factors had positive influence on the performance of the u-Learning systems.

6 CONCLUSION AND DISCUSSION

Under the ubiquitous computing environment, the learner can use any device to exchange information with anyone anytime and anywhere. Based on the characteristics of ubiquity, the area of u-Learning systems has developed by an increase in interactivity; however, there are some crucial aspects needed for the effective launch of u-Learning. There has been little empirical research regarding information systems conducted up to now.

Like other empirical studies, this study has several limitations. First, the questionnaire approach is not free of subjectivity from the respondent. Second, the generalizability of our study is subject to debate. Finally, our study was conducted with a snapshot research approach. More effort is needed to evaluate the validity of our findings.

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